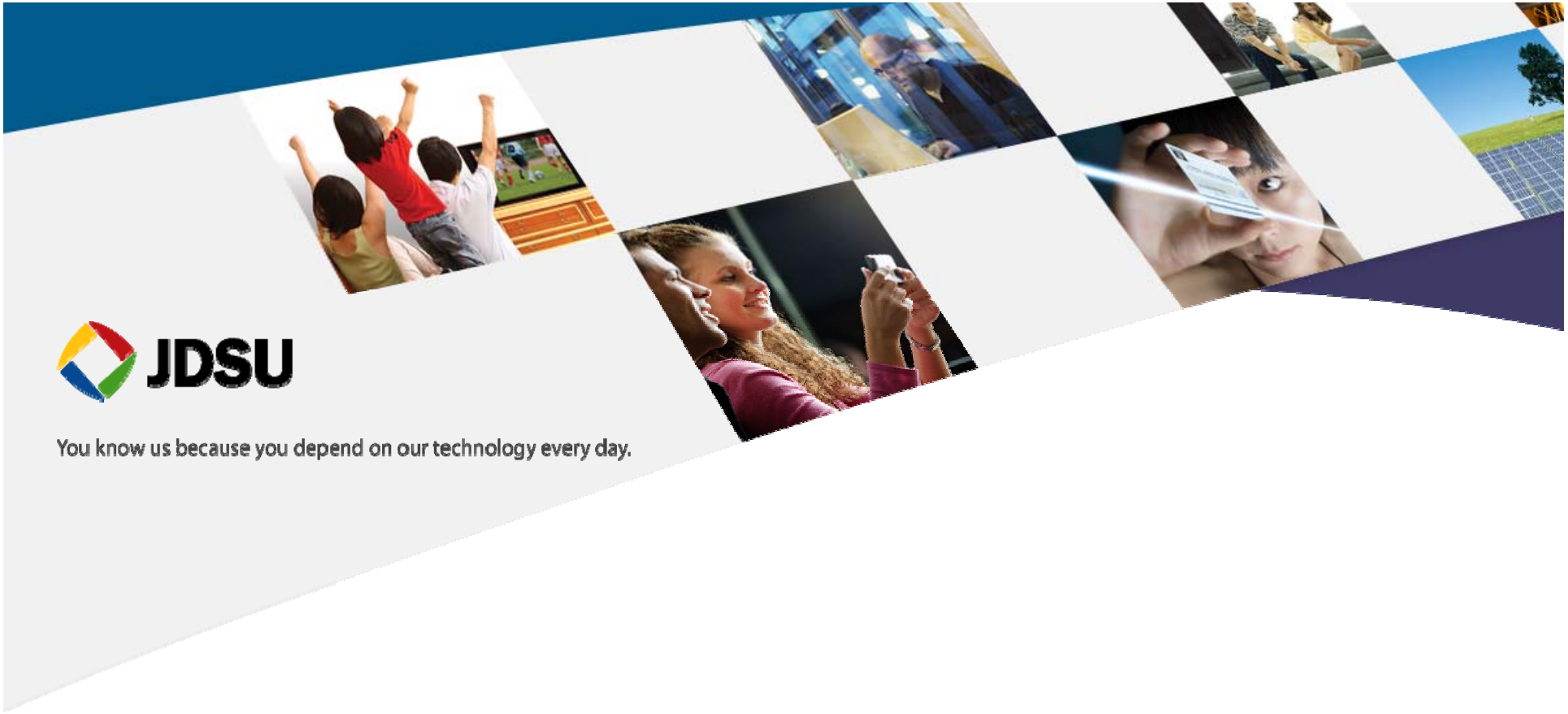

JDS Uniphase
Expanding USF to Broadband

July 7, 2011

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Agenda

- Company Overview
- CommTest Overview
- JDSU Requests New Quality of Service Metrics
  - More than Speed (functionality, performance, scalability, reliability, resiliency of broadband performance)
  - Across all Broadband Services (internet / voice / video / data)
  - Pre-qualification (validate likelihood of quality service)
  - Pro-active Monitoring (jitter, latency, throughput, packet loss)
  - Optimum Testing Locations
  - Specific Testing Standards

A Global Company

Employees	**4,900**
Global Presence	**164 countries** **HQ in Milpitas, CA**
Annual Revenue	**$1.37B (FY10)** **H1FY11 – $888.5M**
Founded	**1923 (T&M)**
Index Membership	**S&P 500**

Business Segments

Communications Test and Measurement (CommTest)

Solutions:
Lab/Field Test and Service Assurance
Applications:
Test, Monitoring and Analysis for Network Equipment and Networks (Telecom, Cable, Wireless, Datacom)
TAM: $7B

Communications and Commercial Optical Products (CCOP)

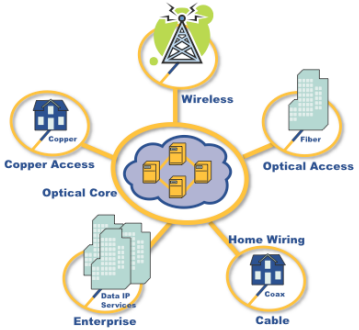
Solutions:
Optical Communications, Commercial Lasers, and Photovoltaics
Applications:
Network Equipment, Industrial and Consumer Products
TAM: $8B

Advanced Optical Technologies (AOT)

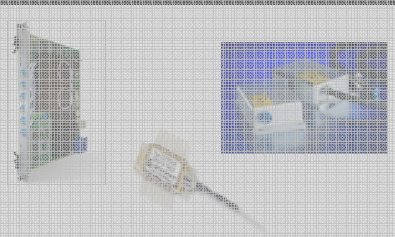
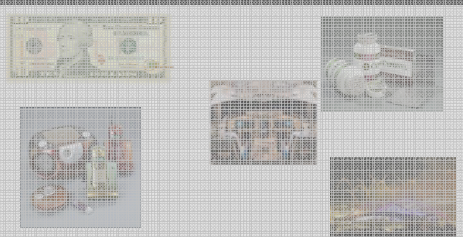
Solutions:
Custom Color, Custom Optics, and Authentication Solutions
Applications:
Currency, Defense, Industrial and Consumer Products
TAM: $6B

Source: Company estimate

JDSU provides test and management solutions from the home, across the network to the NOC



CommTest

Business Segments	Communications & Commercial Optical Products	Communications Test & Measurement	Advanced Optical Technologies
			
Total Market Size (Annual)*	$3.9B	**$2.8B**	$1.5B
Annual Growth Rate*	5-15%	**6-12%**	5-10%
JDSU Market Position*	#1-2	**#1-2**	#1-2
Markets	Telecom, Datacom, Submarine, Long Haul, Metro, Access, Biotech, Microelec,	**Telecom/Cable Access, Metro, Core & Home Networking**	Currency, Defense Authentication, Instrumentation
Sample Customers	Alcatel-Lucent, ASML, Becton Dickinson, Ciena, Cisco, Ericsson, ESI, KLA Tencor, Tellabs, Huawei, Nortel, NSN, Fujitsu	**Alcatel-Lucent, AT&T, British Telecom, China Telecom, Comcast, Deutsche Telekom, Telmex, Verizon**	Astra-Zeneca, Bank of China, HP, ITT, Lockheed Martin, Pfizer, SICPA

* Sources: Central Banks, Frost & Sullivan, Infonetics Research, Ovum-RHK, PIRA Research, Prime Data, US Chamber of Commerce, and internal analysis.

CommTest Value Proposition

We provide:

- Lab & Production Instruments
- Field Service Instruments
- Service Assurance Systems
- Services

For:

- Telecom and Cable Network Operators
- Equipment Manufacturers

Of:

- Broadband / IP networks & services
- Fixed and mobile
- xDSL, FTTx, VoIP, IPTV

That:

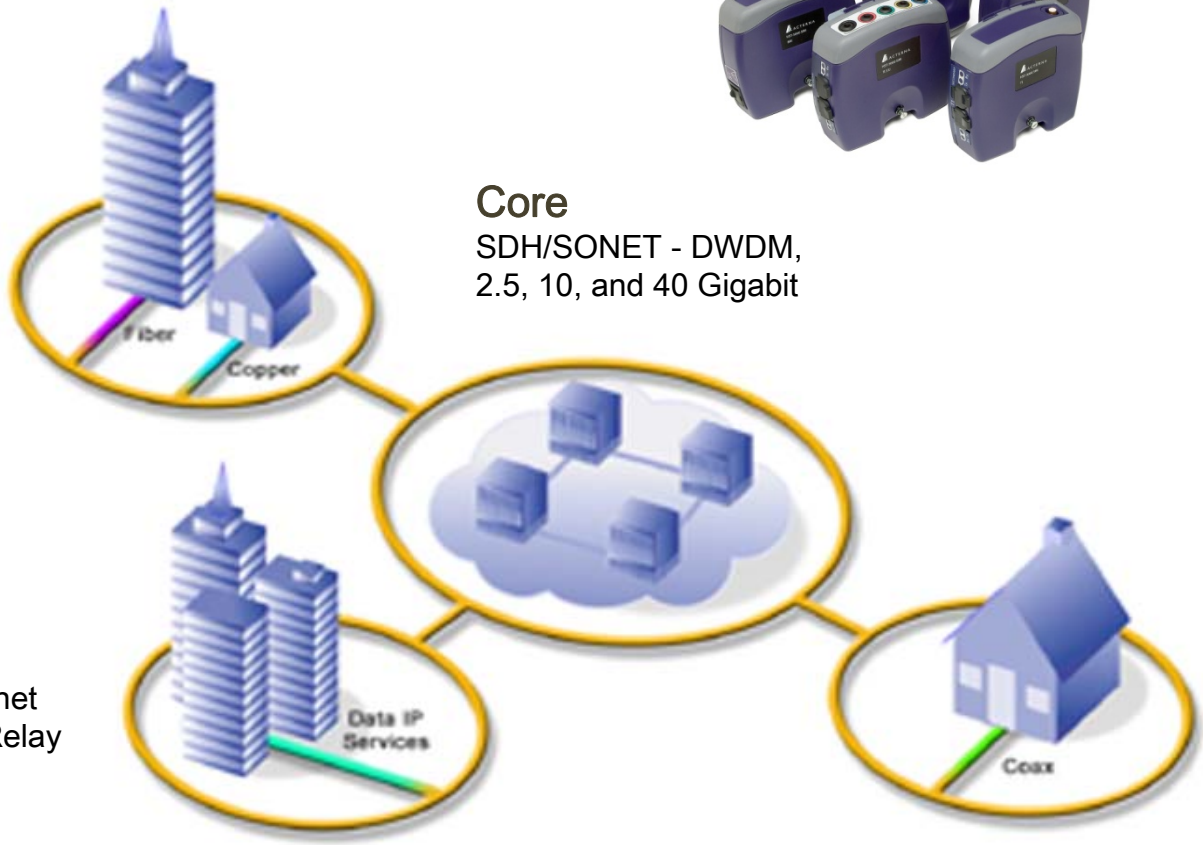
- Accelerate deployment of new services
- Increase productivity and reduce operating expenses
- Improve quality and reduce customer churn

Test and Measurement – Enabling QUAD-Play Services over Optical and Broadband

- **Quad-play testing requirements throughout the network**
- **RF problems can lead to high packet loss**
- **Congestion in CMTS can cause jitter and packet loss**
- **Misconfiguration in PSTN trunks can lead to echo**

Access
FTTx – Copper
xDSL – PON
Metro Ethernet

Core
SDH/SONET - DWDM,
2.5, 10, and 40 Gigabit



Data/IP
Gigabit Ethernet
ATM - Frame Relay
IP-VPNs

Cable
Coax - Cable Modems,
Video on Demand
VoIP - Digital TV

Testing addresses many network and customer issues

Reports

Network and Service Providers' Pain

- Ubiquitous Broadband Infrastructure
- High speed capabilities for high-definition of remote medical consultations, tele-presence, videoconferencing, video-based distance learning….)
- Reduce OpEX (customer calls, dispatches and truck rolls, churn)
- Increase revenue

Test & Monitoring Solution
Pre-Qualification, Pro-active monitoring, On-demand diagnostics

QoE

QoS

Broadband Services

Affordable, robust and reliable broadband services

Must connect every one and deliver high-quality broadband services

Customers' Pain

- All Americans shall have access to affordable broadband services
- Broadband can speed job creation (connectivity for placement / searching)
- Broadband can enhance speed / functionality for on-line learning
- Broadband can accelerate business commencement and growth.
- **"Better speed for less"**

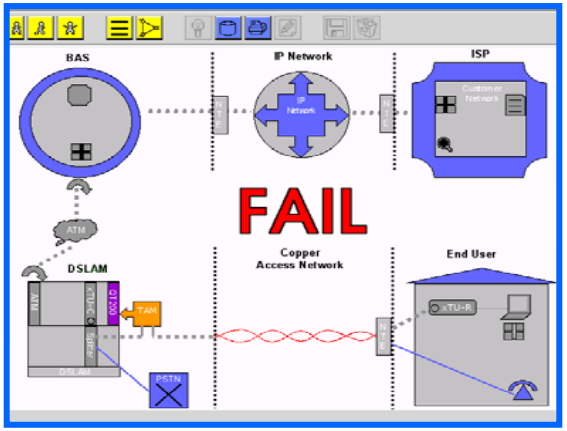
JDSU suggests More Robust Quality of Service Metrics

1. **Prequalification Testing - Critical Points to check**
   - Remote access certification for i) network and ii) home
2. **Proactive Performance Testing**
   - Measure throughput, latency, jitter, and packet loss across all BB service offerings (Internet, data, voice/VoIP, video)
3. **Optimum Testing Locations**
   - Residential Gateway and Set Top Boxes
4. **Specific Testing Standards**
   - DSL Forum for Triple Play Services TR-126

Pre-Qualification – Critical points to check

1. **Perform remote Access network certification**
   - Make sure the access network can support and deliver the expected speed on both transmission ways (Upstream and Downstream) (e.g. Measure Loop Attenuation, Quiet Line Noise and Signal-to-Noise Ratio over xDSL band)
   - Ensure the access network is stable (e.g. no DSL re-resynchronization or link retrain, Adaptation to time varying line conditions)
   - Identify potential intermittent disturbers that would impact the Customer experience
   - Identify problems in access network quickly and accurately; Avoid unnecessary truck rolls and false dispatches
   - Most problems are caused because the network is not provisioned properly
   - Copper problems are due to poor line pre-qualification
2. **Perform remote Home certification**
   - Ensure the Home LAN networks are stable and error-free (WiFI, Ethernet, HPNA, MoCA…)
   - Check service availability (Internet, data, Voice/VoIP, Video)
   - Customer problems are due to modem interoperability and bad configuration

✘ **Without the right tools, Customer facing operation can rarely provide acceptable answer**



Pre-Qualification: Make sure the access network is capable to transport the Broadband Services

Key parameters:

- Upstream & Downstream Bit Rate Prediction
- Bandwidth / speed stability
- Capability to operate at higher speed

- *Attenuation versus frequency*
- *Spectrum analysis / CrossTalk*
- *Interference /Radiated emissions*
- *Impulse noise*
- *Line length*

Pre-Qualification tests

Central Office
Local Exchange

Fibre

Fibre

HFC Hub
xDSL / Street cabinet

FTTH, xDSL
(ADSL2+, VDSL)

Coax

FTTH

Existing Narrowband Line Test Systems might be useless as broadband services will be not connected on PSTN switches anymore

Pro-active Service Monitoring

- Perform Proactive Testing of services such that failures are detected before the customer experiences a problem
- Get a real visibility of the service availability : Measure the real customer experience
  - Tolerance to Video failure is seconds/minutes not hours (e.g. The TV is assumed to be a service which works 24 / 7 without any interruption or almost no image freeze . Subscriber does not accept a disconnection of service during a movie).
  - Pro-active monitoring of the availability of the service is required
  - BUT Trouble shooting has to be efficient to pre-locate faults instantly
- Provide evidence of changed condition: Consolidate, Aggregate and correlate pro-active measurements to identify dark spots in the network
- Share test unified test resources between NOC, Field technician, provision and Service Provider(s).
- ✘ **Dispatch to fix (not to find) and enable on-site technician to perform the full job**

Pro-active Service monitoring

Key parameters:

- ***Measure the "real Customer experience"***
  - ***Internet Service*** *(IP throughput, Packets lost /dropped…)*
  - ***VoIP Service*** *(RTP Packets lost /dropped; Local and far-end jitter…)*
  - ***Video (multicast and VoD):*** *IGMP (channel zapping), RTSP (VoD), MPEG2-TS analysis (channel check, lost MPEG frame, MPEG timing….)*

Pro-Active Monitoring

Central Office
Local Exchange

Fibre

Fibre

HFC Hub
xDSL / Street cabinet

FTTH

Why monitoring Customer experience from the Residential Gateway (RG) and Set Top Box (STB)?

- Broadband Forum has defined Technical Requirements that allow:
  - Automatic CPE device configuration (Zero-touch provisioning)
  - CPE firmware upgrade
  - On-demand testing
  - Pro-active monitoring
  - "TR-069" has been adopted for Broadband Wireline services, started to be used by Cable Operators, Femtocell Forum, WiMax Forum….
  - Based on standardized « data models » for each type of broadband services (TR-098 – Internet/data, TR-104 – VoIP, TR-135 – Video, TR-196 – Femtocells…)
- Widely adopted by CPE vendors and Service Providers
- Provides visibility into the home
- Allows to measure the real customer experience
- No extra cost for the end-user (no probe, no test equipment, no software agent required)

Broadband Forum TR-126

Triple-Play Services Quality of Experience (QoE) requirements

- For triple play applications delivered through a broadband infrastructure: video (video on demand, and broadcast video), voice, and best-effort data (web browsing, gaming).
- Agnostic to access technology (xDSL, xPON, etc.), services architecture, and implementation
- Defines the recommended minimum end-to-end quality of experience (QoE) guidelines in terms of engineering objective measures from the perspective of the end user.
- Provides consistent, baseline subjective QoE for end users
- Can be complemented by additional technical requirements (e.g. TR-160 - IPTV Performance Monitoring)

Q&A

You know us because you depend on our technology every day.